L Number	Hits	Search Text	DB	Time stamp
1	19424	paging	USPAT; US-PGPUB; EPO; JPO	2004/03/07 10:59
2	2428324	few$2 less$2	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:00
3	245314	symbol$1	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:00
4	227905	message$1	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:00
5	130	(few$2 less$2) with symbol$1 with message$1	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:00
6	94730	error$1 near2 correct$4	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:01
7	2	paging and ((few$2 less$2) with symbol$1 with message$1) and (error$1 near2 correct$4)	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:04
8	173	decod$3 with (few$2 less$2) with message$1	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:05
9	25	paging and (error$1 near2 correct$4) and (decod$3 with (few$2 less$2) with message$1)	USPAT; US-PGPUB; EPO; JPO	2004/03/07 11:05

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TITLE: Method of and system for communicating messages

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INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Sharpe; Anthony K.	Taversham	N/A	N/A	GB2
Mabey; Peter J.	Comberton	N/A	N/A	GB2

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ABSTRACT:

A method of, and system for, communicating messages in an environment which is subject to fading, in which data to be transmitted is encoded and formatted, a checksum is determined for said encoded and formatted data and in which the checksum is added to an address code word which is concatenated with the encoded and formatted message code words to form a message. A receiver is energized for receiving transmissions in its predetermined frame. In response to recognizing its address code word the concatenated code words are decoded and stored. As each code word is stored, substantially simultaneously a checksum is computed for the message assembled so far and is compared to the checksum in the address code word, if and when they are equal it is concluded that a complete message has been received and further analysis of the stored message is terminated. In a variant of the present invention each message is transmitted at least twice and a final version of the message is assembled code word by code word by comparing the corresponding code words in the respective transmissions and selecting the better (or best) version. As the final version is being assembled the checksum is computed and compared to determine the end of the message. In a further variant the detection of an address or idle code word following a message code word is treated as the beginning of a new message and the computed checksum is used when an undecodable code word is

received.

16 Claims, 14 Drawing figures

Exemplary Claim Number: 12

Number of Drawing Sheets: 7

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Brief Summary Text - BSTX (5):
For convenience of description the present invention will be described with
reference to a high speed paging system which has been evolved from, and is
compatible with, POCSAG or CCIR Radiopaging Code No 1, the details of which are
disclosed in "The Book of the CCIR Radiopaging Code No 1" available from the
Secretary, RCSG, British Telecom, Radiopaging, 23 Howland Street, London W1P
6HQ. In accordance with POCSAG, paging messages are transmitted in batches
each of which comprises a synchronisation code word and 8 frames each
comprising 2 code words. Each pager or secondary station is assigned to a
particular frame which means that if a paging signal is transmitted by a
primary station for a particular pager, it will be in a predetermined one of
the 8 frames. Each POCSAG pager is controlled to power up in order to be able
to receive the synchronisation (sync) code word and again for the duration of
its particular frame. In the case of messages, the message code words are
concatenated with the address code word. The POCSAG address and message code
words each comprise 32 bits of which the first bit has a value "0" for an
address code word and "1" for a message code word. Both types of code words at
bit positions 22 to 31 comprise cyclic redundancy check (CRC) bits and the bit
32 provides an even parity. At the end of a message any waiting address code
words will be transmitted, starting with the first appropriate to the first
free frame. In the absence of an appropriate address code word, an idle code
word, which is a non-allocated address code word is transmitted. By using
address or idle code words in this way it is unnecessary to send specific end
of message code words and/or message length indicators which not only reduces
the time required to transmit a message but also increases its chances of being

received successfully.

Brief Summary Text - BSTX (6):
The use of a 10 bit CRC provides the capability of 2-bit error correction.
Interleaving the bits of blocks of successive code words will provide an improved degree of protection particularly in the event of fades. Decoded address code words occurring in a particular frame can be compared against the addresses stored by the pager and if it is determined that there is adequate correspondence between them, the message is accepted. However, this option is not available with message code words. European Patent Specification EP-B1-0 117 595 discloses the use of checksums as a means of protecting against falsing, that is incorrect correction by one or more data code words when using 2-bit error correction.

Brief Summary Text - BSTX (11):
According to a second aspect of the present invention there is provided a system for transmitting and receiving data messages, comprising means for calculating and embedding a checksum in each message, means for transmitting the message, means for receiving the transmitted message, means for error correcting the message, if required, means for storing successive code words, means responsive to the addition of each code word to the stored code words, for determining a checksum using the same algorithm as was used to calculate the checksum in the originally transmitted message, and means for recording when the determined checksum corresponds to that embedded in the originally transmitted message.

Drawing Description Text - DRTX (3):
FIG. 1 is a diagram illustrating a paging system,

Detailed Description Text - DETX (3):
The paging system shown in FIG. 1 comprises a paging controller 10 which receives paging requests and formats the addresses and messages in accordance with the protocol being used. The paging controller 10 is connected to a plurality of base station transmitters 12A,12B which are operated in a quasi-synchronous mode. A plurality of digital pagers or secondary stations SS1,SS2 are free to roam within the coverage area of the base stations 12A,12B.

The operation of, and battery economising features of, the pagers SS1,SS2 correspond to that determined by the protocol being followed.

Detailed Description Text - DETX (4):
In the present example shown in FIG. 2 the paging protocol used comprises
successive cycles having a duration of 6.8 seconds. Each cycle comprises 3
batches B0,B1,B2, each having a duration of 2.267 seconds and each batch comprises a 32 bit sync code word and n frames each comprising m code words
(CW), where for example at a data rate of 6400 bits per second n=28, m=16 and
each code word is 32 bits long, however variants of this example are possible.
Referring to FIGS. 3A and 3B, each message commences with a 32 bit address code
word ADD which is concatenated with a plurality of message code words M. As is
customary with POCSAG, the first bit of an address code word has a value "0"
and that of a message code word has a value "1". Similarly each type of code
word has a 10 bit cyclic redundancy check (CRC) word for error detection followed by an even parity bit (P). In order to guard against falsing at the
receiver a checksum CSM is added. In FIG. 3A the checksum CSM is embedded as 4
bits of the address code word leaving 16 bits for the actual address. In FIG.
3B the checksum CSM is embedded in the first message code word M1 or, if provided, in a vector field located between ADD and M1. One method of determining the checksum is to sum the actual message only bits, that is 20
bits per message code word, divide the sum by a polynomial and the remainder is
the checksum. The end of a message is denoted by the presence of an address
code word relating to the next following message.

Detailed Description Text - DETX (5):
Secondary stations SS are allocated to respective pre-determined frames of a
batch and in order to save current the receiver of a secondary station is controlled to be energized (or active) to receive the sync code word S and
subsequently for its pre-allocated frame in the batch. The paging controller
10 (FIG. 1) arranges for messages which are directed to a secondary station to
be transmitted commencing in its allocated frame.

Detailed Description Text - DETX (6):
In accordance with the present invention the inclusion of a checksum CSM in

the address code word or the first message code word provides error
protection
which enables 2 bit error correction to be applied in each code word.
Additionally as will be described it can be used to detect the end of a
data
message without requiring either an end of message code word or an
address or
idle code word which may have been lost or corrupted due to a fade.

Detailed Description Text - DETX (7):

In operation a secondary station is energized in its pre-allocated
frame and
receives a sequence of signals. It is assumed for the purposes of
illustration
that in the sequence there is a message comprising an address code word
ADD and
three message code words M1, M2, M3 (see FIG. 4A for example). As each
code
word is received it is error corrected, if required, and stored. Once
the
first complete code word has been stored, it is decoded and as it is an
address
code word ADD a check is made to see if it corresponds to one of the
address
code words allocated to the secondary station. If it is and the address
code
word contains a checksum, the checksum is stored. In this example the
next
following code word is a message code word M1 so that after error
correction,
if applicable, a checksum is calculated by a processor in the receiver
using
the same algorithm as was used in the paging controller and the
calculated
checksum is compared with the checksum which has been stored. Assuming
that it
is not equal the sequence is repeated for the next following message code
word
M2 and once again the checksums are not equal. The sequence is repeated
again
with the third message code word M3 and this time, the checksum
calculated over
3 message code words does equal the checksum which was stored. The
processor
in response to receiving an indication that the checksums correspond
stops
further analysis of the received sequence ol signals on the assumption
that a
complete message has been received. This conclusion is made on the basis
of
the signals as received without having to verify it by checking if the
next
following code word is an address or idle code word. An advantage of not
having to decode the next following code wore is that it reduces the
overhead,
which is 25% for a 4 code word message and the fewer the number of code
words

which have to be decoded the greater the success rate. The complete message which has been decoded may be displayed or stored for later display.

Detailed Description Text - DETX (13):
FIG. 4A illustrates a transmission in a frame commencing with address code word ADD1 concatenated with message code words M1,M2,M3. Other messages beginning with respective address code words ADD2,ADD3 are concatenated with the first message. At the secondary station, its receiver is powered up for its respective frame, and, when possible, corrects any errors prior to storing all the code words that might belong to a message for it. Storing will continue, into the following frames if necessary, until a positive indication that the message for the secondary station has terminated, for example the start of a subsequent message for another station is received.

Detailed Description Text - DETX (14):
The corresponding code words in the next following batch (FIG. 4B) are received, error corrected, if required, and compared with the corresponding code words stored previously. Decodable code words from the repeat transmission are used to fill in the gaps due to undecodeable code words in the previous transmission. Having decoded an address code word ADD1 which is one assigned to the secondary station, the checksum CSM is noted. For each of the decodeable message code words following ADD1, commencing with M1, a checksum is determined by using the same algorithm as is used to determine the checksum in the message prior to its transmission. The checksum is compared with that in ADD1 and if they do not agree, then the process repeats with M2,M3 and so on until either the checksums do correspond at which point further analysis is terminated because it is assumed that that is the end of the message or another address code word is received. The assembled message is shown in FIG. 4C.

Detailed Description Text - DETX (31):
Block 79 indicates the start of the flow chart. Block 81 denotes energizing the secondary station for its predetermined frame. Block 83 relates to the operations of error correcting and decoding signals received in the frame. Block 85 indicates checking if a decoded address corresponds to one of

those allocated to the secondary station. If the answer is No(N) the flow chart reverts to the block 83. However if the answer is Yes(Y), then in block 87, the checksum CSM is recovered from the address code word and stored.

Detailed Description Text - DETX (32):

Block 89 denotes error correcting and decoding successive message code words. In block 91 a check is made to see if the message code word is decodable. If the answer is Yes(Y), then in block 93 a check is made if the code word is a message code word. If the answer is Yes (Y) the message code word is concatenated with any previously decoded message code words concatenated with the address code word, block 95. In block 97, a checksum is calculated using the same algorithm as was used in the primary station. The stored and calculated checksums are compared, block 99. In block 101 a check is made to see if the checksums are the same and if they are not the flow chart reverts to the block 89. However, if they are the same, the message is deemed to have been complete and in block 103 the message is displayed and/or stored for display later. Block 109 relates to resetting the flow chart to the block 81.

Detailed Description Text - DETX (38):

FIG. 10 is a flow chart relating to determining the end of a message when the message is repeated. Block 82 relates to the energization of the receiver for a predetermined frame in n successive batches where n is an integer typically between 2 and 4. Block 84 relates to decoding any signals which are received and are capable of being decoded, which operation may include error correcting code words. Block 86 relates to detecting an address code word indicating the commencement of the next following message. The stage 88 relates to checking if an address code word has been detected, if the answer is No (N) then the decoding of received data continues but if the answer is Yes (Y) then the flow chart proceeds to blocks 90a to 90n which relate to storing several transmissions made in the corresponding flames of a predetermined number of batches, the number of repeat transmissions of the same message being a constant of the communication system.

Detailed Description Text - DETX (39):

Block 92 relates to combining code words in the respective stored transmissions. One or more of various known techniques may be used, for example selecting a code word which has been correctly error corrected rather than one which has too many errors to be corrected by the error correction algorithm used or using majority logic particularly if three or more transmissions are stored by respective blocks 90a to 90 n. Block 94 denotes recovering and storing the checksum in the address code word. As each code word is concatenated with previously accepted code words in a message store, a checksum is generated block 96. Block 98 denotes comparing the generated checksum with the checksum recovered from the address code word. In block 100 a decision is made as to whether or not they agree, if they do not agree (N) the cycle of combining code words, calculating a new checksum, and comparing checksums is repeated. If the checksums agree (Y) an end-of-message flag is generated, block 102, which inhibits any further combining of code words and erases any of the data which is stored by operations in blocks 90a to 90n. Block 104 relates to storing the message in the RAM 68 and block 106 relates to resetting the secondary station.

Claims Text - CLTX (7):

7. A method as claimed in claim 1, including the steps of transmitting each message at least twice; receiving the first transmission of the message; error correcting the code words if required; decoding each code word and storing the decoded code word; receiving each repeat of the message, error correcting the code words of each received message repeat, if required; decoding each code word, storing the repeated message code word by code word; commencing with the stored version of the first message, assembling a final version of the message by comparing corresponding code words in the first message and each repeat thereof; after each code word has been added to the final version of the message being assembled, determining the checksum using the same algorithm as used to determine the checksum in the originally transmitted message, and, if the checksum so determined corresponds to that embedded in the originally transmitted message, terminating further comparison of the original and the repeated message(s).

Claims Text - CLTX (12):
12. A system for transmitting and receiving data messages, comprising means for calculating and embedding a checksum in each message, means for receiving the transmitted message, means for error correcting the message, if required, means for storing successive code words, means responsive to the addition of each code word to the stored code words, for determining a checksum using the same algorithm as was used to calculate the checksum in the originally transmitted message, and means for recording when the determined checksum corresponds to that embedded in the originally transmitted message.

Claims Text - CLTX (13):
13. A system for transmitting and receiving data messages, comprising means for calculating and embedding a checksum in each message, means for transmitting the message and at least one repeat thereof, means for receiving the original transmission of the message and each repeat of the message, means for error correcting the message and each repeat thereof, if required, means for storing successive code words of the message by storing the repeated message(s) code word by code word, means for assembling a final version of the message and for comparing corresponding code words in the originally received message and each repeat thereof, means, responsive to the addition of each code word to the final version of the message being assembled, for determining the checksum using the same algorithm as used to calculate the checksum in the originally transmitted message, means for determining that a complete message has been received in response to the calculated checksum corresponding to that embedded in the originally transmitted message, and means for terminating further comparison of the original and the repeated message(s).